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UTILITY PATENT APPLICATION TRANSMITTAL <small>(Only for new nonprovisional applications under 37 C.F.R. § 1.53(b))</small>	Attorney Docket No.	14792-1US JA/AA/mb
	First Inventor or Application Identifier	LUNEAU, Louis
	Title	MULTI-PROTOCOL RECEIVER
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APPLICATION ELEMENTS See MPEP chapter 600 concerning utility patent application contents.	ADDRESS TO: Assistant Commissioner for Patents Box Patent Application Washington, DC 20231
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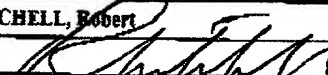
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MULTI-PROTOCOL RECEIVER

FIELD OF THE INVENTION

5 The present invention relates to wireless receivers. More precisely, this invention describes a multi-protocol receiver for intercepting, monitoring and/or recording conversation over a cellular network.

BACKGROUND OF THE INVENTION

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With the increasing complexity of telecommunication means, criminals are finding new ways to escape from the surveillance of the police or other law enforcement agencies. This can, potentially, become a threat to society. More specifically this problem is increasing with the global development of mobile telecommunication means.

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The term mobile telecommunication can include technologies ranging from cordless telephones, digital cellular mobile radios, and personal communication systems that are evolving to wireless data and networks.

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A mobile telecommunication system is usually composed of a base station 13, connected to the public telephone network via a Mobile Telephone Switching Office (MTSO), and of a group of mobile users 14. The base station 13 covers a certain geographical area.

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A communication between a mobile user and a standard public network user is thus performed using the base station 13. Each communication link uses a particular frequency band known as a voice channel. The uplink transmission refers to the signal sent by a mobile station 14 to a base station 13, while the downlink transmission refers to a signal sent by the base station 13 to a mobile station 14. Therefore, a single conversation requires two voice channels. The monitoring of a particular conversation implicitly requires the monitoring of the two voice channels. One prior technique for monitoring cellular telephone

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conversations involves a simple tuner that scans voice channels. This technique is not efficient when the number of communications to handle is high and when the frequency of the voice channel changes often.

5 A second technique consists of monitoring the two voice channels and the traffic channels of the communication system in order to handle the handover (i.e. when a user, by a physical displacement, changes base stations). Thus it is possible to track a user through a cellular network.

10 Focusing more precisely on wide band receivers, the prior art comprises one type of system which is composed of a group of front end radio frequency demodulation stages which include parallel narrow-band receivers. Usually, the Radio Frequency (RF) band coverage provided by these narrow-band receivers is of adjacent frequency. Each RF stage has its own local oscillator frequency and Intermediate Frequency (IF) stages. Such a system is very costly because only one RF stage is working at a time. The inactive RF stages are superfluous
15 during operations.

In another configuration (described in patent US6,002,924 col 1, line 57 to 67), the choice of the first IF and the first local oscillator, the second IF and the second local oscillator allow the user to access a broad band radio receiver. However, because of inter-modulation and image frequency response, certain
20 frequencies are not available. This element is unacceptable for the purpose of this use.

In US patent 6,002,924, Takano succeeds to create a broadband radio receiver with a continuous spectrum. However, there is still a gap to fill in order to complete the task of intercepting users because for each voice interception, two
25 receivers are needed; this is too costly therefore this is not acceptable. Furthermore, the processing of the RF signal is completed using an analog processing. This analog receiver architecture has the serious drawback to use multiple mixers and filters. Furthermore, the analog receiver architecture is subject to temperature drift and mismatch from part variations.

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SUMMARY OF THE INVENTION

It is an object of the present invention to provide an efficient architecture that will avoid one or more of the shortcomings of the conventional technology.

It is an object of the present invention to provide a scanner for mobile
5 telecommunications.

It is an object of the present invention to provide a scanner for mobile communications that will be able to handle simultaneously a consequent number of conversations coming from any part of the available frequency bands.

Another object of the present invention is to provide a scanner that will be
10 able to cope with various frequency bands.

Another object of the present invention is to provide a scanner that will be able to cope with various telecommunications protocols.

Yet another object of the present invention is to provide a receiver that can be software controlled.

Yet another object of the present invention is to provide a scanner in
15 which there is a possibility to achieve a protocol upgrade of the system.

Yet another object of the present invention is to provide a scanner in which there is a possibility to achieve a frequency band update of the system.

Yet another object of the invention is to provide a scanner in which there is
20 a possibility to add other users to the system.

According to one aspect of the invention, there is provided a method for scanning a group of mobile telecommunication users. The method comprising the steps of:
collecting a wideband frequency signal using an antenna, performing a first
25 demodulation of the wideband frequency signal to obtain a demodulated wide band signal; digitizing the demodulated signal to obtain a digital demodulated signal; routing the digital demodulated signal to a device which performs on the digital demodulated signal a narrowband extraction, performing the narrow band extraction on the digital demodulated signal and generating an in-phase
30 component and a quadrature component for a selected voice channel.

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In accordance with another aspect of the present invention, there is provided an apparatus for monitoring the communications of a group of mobile users. The apparatus first comprises at least one demodulation unit, also called RF receiver unit, a number of demodulation units depending on a number of different frequency bands that are targeted to be monitored. Each demodulation unit is composed of two separate circuits that are each dedicated to the scanning of a downlink transmission and an uplink transmission. The apparatus also comprises an Analog to Digital Converter (ADC) whose goal is to convert the analog signal into a digital signal. The apparatus also comprises a Central Processing Unit (CPU), which routes the signal through the Digital Down Converters (DDC) and commands the demodulation unit. The narrow band extraction is performed at this stage. Finite Input Response (FIR) filtering is also performed. The output signal can be decoded by a processing unit in accordance with the protocol that was used to encode the information.

According to another aspect of the invention, there is provided a method for tracking a mobile. The method comprising the steps of: requesting from a user at least one wireless conversation to monitor, receiving at least one control channel signals using a control channel receiver, processing said received control channel signals according to at least one of said wireless conversations to monitor to provide at least one voice channel, each one of said voice channels corresponding to one wireless conversations to monitor, storing in a memory a relation between one of said wireless conversations to monitor and one of said voice corresponding voice channel, setting, using pre-recorded data on the type of wireless telecommunication protocol and frequency band coming from a non-volatile memory, the parameters of the filters, the frequency of the down converters, and the paths in the switch in order to track said users.

BRIEF DESCRIPTION OF THE DRAWINGS

The invention will be better understood by an examination of the following description, together with the accompanying drawings, in which:

Fig. 1 shows an overview of a base station and mobile unit wideband scanner;

Fig. 2 shows the RF stage and the processing unit, the RF stage comprises four RF units; the system depicted there can process four different full duplex conversations coming from four different frequency bands;

Fig. 3 shows the RF unit that can process a full duplex wireless conversation;

Fig. 4 shows a DDC unit and a filter stage that can process a full duplex wireless conversation;

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DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

While the present invention may be provided in various embodiments, there is shown in the drawings and described in the following text a specific preferred embodiment, with the understanding that the present description is only one embodiment and is not limiting of scope of the invention.

Fig 1 presents one embodiment of the invention. The system in the preferred embodiment is a scanner, that is a device which monitors transmission from either a base station 13 or a mobile 14. Such a device is used typically by police for lawful intercept of cellular telecommunications. An antenna 10 collects the radio signals coming from the base unit 13 and the mobile unit 14. A demodulation unit 11 handles radio signals. The demodulation unit 11 provides the IF signal to the processing unit 12. The RF unit 11 imposes limitations on this signal in order to prevent it from being harmful for the following stages. The processing unit 12 is able to select parts of the wideband signal coming from either a base unit 13 or a mobile unit 14. A management unit 15 controls the processing unit 12 and get signals from the RF unit 11. In a preferred embodiment, the management unit 15 comprises a computer with a data acquisition hardware and a software.

Fig 2 shows the different parts of the architecture of the system in the preferred embodiment.

Each unit 16, composed of a RF stage 11 and an ADC stage 21, is capable to collect the base station signal and the mobile station signal of a certain frequency band. In the preferred embodiment, the scanner is able to tap simultaneously four different frequency bands because the device is composed of four units 16. Each RF unit 11 sends a power information signal 33 to the management unit 15. The ADC stage 21 is connected to a router 22 that is, in the preferred embodiment, a Field Programmable Gate Array (FPGA). The router 22 is controlled by the management unit 15 using signal 36. Next to the router unit 22, a group of DDC units 23 are connected via a bus 28. Finally a filter stage 24 is connected to each DDC unit 23 using signals 29 and 30. This filter stage 24 is controlled by the management unit 15 using signal 35. The filter stage 24 provide signals 31 and 32 to the demodulation units. The demodulation units are not shown in Fig. 2, and may comprise standard demodulation circuits for extracting information from the regular bandwidth signal according to the wireless transmission protocol of each regular bandwidth signal, e.g. TDMA, AMPS, GSM.

The antenna 10 receives the radio signal. Typically, the signal power ranges between -110dBm and -14dBm.

In the case of a cellular system, the frequency band is located between 824 MHz and 894 MHz. The uplink band is located between 824 MHz and 849 MHz, while the frequency band located between 869 MHz and 894 MHz is dedicated for downlink communications.

In the case of a Personal Communication Service (PCS) system, the frequency band is located between 1850 MHz and 1990 MHz. The uplink frequency band is located between 1850 MHz and 1910 MHz, while the downlink frequency band ranges from 1930 MHz and 1990 MHz. The downlink frequency band is shared into two frequency bands: the low downlink frequency band which is located between 1930 MHz and 1960 MHz, and the high downlink frequency band which

is located between 1960 MHz and 1990 MHz. The uplink frequency band is shared into two frequency bands: the low uplink frequency band which is located between 1850 MHz and 1880 MHz, and the high uplink frequency band which is located between 1880 MHz and 1910 MHz.

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The RF unit 11, described in Fig 3, filters and amplifies the incoming signal 20, collected by the antenna 10. More precisely, a duplexer divides the signal 20 into two different signals 80 and 81, corresponding to the downlink and the uplink transmission. Thus, these separated signals 80 and 81 can be sent to two different parts: a mobile RF stage (which comprises elements : 61, 62, 63, 64, 65, 66, 67, 68, 69) and a base RF stage (which comprises elements : 51, 52, 53, 54, 55, 56, 57, 58, 59). These two different stages allow the scanning of either the radio signals coming from the mobile unit 14 or the radio signals coming from the base unit 13.

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In both cases, the signal collected by the antenna 10 is filtered by filter.

In the case of a base station signal, the filter is filter 51 which will only select frequency signals located between 869 and 894 MHz in the case of a cellular system. In the case of a PCS system, filter 51 only selects frequency signals located between either 1930 MHz and 1960 MHz (low part of the base station signal) or 1960 MHz and 1990 MHz (high part of the base station signal).

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In the case of a mobile station signal, the filter 61 only selects frequency signals located between 824 MHz and 849 MHz in the case of a cellular system.

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In the case of a PCS system, filter 61 only selects frequency signals located between either 1850 MHz and 1880 MHz (low part of the mobile signal) or 1880 MHz and 1910 MHz (high part of the mobile signal).

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In the case of a base station signal, a RF amplifier 52 amplifies signal 82 coming from the frequency filter 51. In the case of a mobile signal, the RF amplifier 62 amplifies signal 92 coming from the frequency filter 61.

In the preferred embodiment, and in the case of a cellular system, the local oscillator 53 comprises an ultra low noise TCXO local oscillator followed with a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, an amplifier, an harmonic filter and an amplifier. The harmonic filter is a bandpass filter that will reject non desired harmonics.

In the case of the cellular system, the frequency of the ultra low noise TCXO local oscillator is 117 MHz. Thus, the oscillator 53 generates a signal 84 with a frequency of 936 MHz. In the case of the cellular system, the local oscillator 53 calibrated at 936 MHz, is connected to a mixer 54. Such a system will translate the signal from a central frequency of 881.5 MHz down to a central frequency of 54.5 MHz, that has been chosen in order to be compatible with the central frequency of the following filter 55. The bandwidth will remain 25 MHz.

In the case of a PCS low-band base station signal, the frequency of the ultra low noise TCXO local oscillator is 118.125 MHz. The ultra low noise TCXO local oscillator is followed by a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, an amplifier, an harmonic filter and an amplifier. Thus, the oscillator 53 generates a signal 84 with a frequency of 1890 MHz. In the case of a PCS low-band base station signal, the local oscillator 53 calibrated at 1890 MHz is connected to a mixer 54. Such a system will translate the signal from a central frequency of 1945 MHz down to a central frequency of 55 MHz, that has been chosen in order to be compatible with the central frequency of the following filter 55. The bandwidth will remain 30 MHz.

In the case of a PCS high-band base station signal, the frequency of the ultra low noise TCXO local oscillator is 120 MHz. The ultra low noise TCXO local oscillator is followed by a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency

multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, an amplifier, an harmonic filter and an amplifier. Thus, the oscillator 53 generates a signal 84 with a frequency of 1920 MHz. In the case of a PCS high-band base station signal, the local oscillator 53 calibrated at 1920 MHz is
5 connected to a mixer 54. Such a system will translate the signal from a central frequency of 1975 MHz down to a central frequency of 55 MHz, that has been chosen in order to be compatible with the central frequency of the following filter 55. The bandwidth will remain 30 MHz.

10 A local oscillator 63, in the case of a mobile signal, is connected to a mixer 64. In the preferred embodiment, and in the case of the cellular system, the local oscillator 63 comprises an ultra low noise TCXO local oscillator followed with a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by
15 a factor of 2, an amplifier, an harmonic filter and an amplifier. The harmonic filter is a bandpass filter that will reject non desired harmonics.

In the case of the cellular system, the frequency of the ultra low noise TCXO local oscillator is 97.75 MHz. Thus, the oscillator 63 generates a signal 94 with a frequency of 782 MHz. In the case of a mobile cellular frequency band, the local
20 oscillator 63 calibrated at 782 MHz is connected to a mixer 64. Such a system will translate the signal from a central frequency of 836.5 MHz down to a central frequency of 54.5 MHz, that has been chosen in order to be compatible with the central frequency of the following filter 65. The bandwidth will remain 25 MHz.

25 In the case of a PCS low-band mobile station signal, the frequency of the ultra low noise TCXO local oscillator is 120 MHz. The ultra low noise TCXO local oscillator is followed by a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by
30 a factor of 2, an amplifier, an harmonic filter and an amplifier. Thus, the oscillator 63 generates a signal 94 with a frequency of 1920 MHz.

In the case of a PCS low-band mobile station signal, the local oscillator 63 calibrated at 1920 MHz is connected to a mixer 64. Such a system will translate the signal from a central frequency of 1865 MHz down to a central frequency of 55 MHz, that has been chosen in order to be compatible with the central frequency of the following filter 65. The bandwidth will remain 30 MHz.

In the case of a PCS high-band mobile station signal, the frequency of the ultra low noise TCXO local oscillator is 121.875 MHz. The ultra low noise TCXO local oscillator is followed by a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, a signal amplifier, a frequency multiplier, by a factor of 2, an amplifier, an harmonic filter and an amplifier. Thus, the oscillator 63 generates a signal 94 with a frequency of 1950 MHz. In the case of a PCS high-band mobile station signal, the local oscillator 63 calibrated at 1950 MHz is connected to a mixer 64. Such a system will translate the signal from a central frequency of 1895 MHz down to a central frequency of 55 MHz, that has been chosen in order to be compatible with the central frequency of the following filter 65. The bandwidth will remain 30 MHz.

In all cases, and in the preferred embodiment, the multiplication of the signals provided by the mixer is completed with a high S/N ratio.

In the case of a base cellular signal, a filter 55, with a central frequency of 54.5 MHz only selects the desirable bandwidth, i.e. 25 MHz, of the incoming signal 85. In the case of a PCS base signal, the filter 55, with a central frequency of 55 MHz, will only select the desirable bandwidth, i.e. 30 MHz, of the incoming signal 85.

In the case of a mobile cellular signal, a filter 65, with a central frequency of 54.5 MHz only selects the desirable bandwidth, i.e. 25 MHz, of the incoming signal 95

In the case of a PCS mobile signal, the filter 65, with a central frequency of 55 MHz, will only select the desirable bandwidth, i.e. 30 MHz, of the incoming signal 95.

- 5 In the case of a base signal, an IF amplifier 58 boosts the selected signal 86 after filter 55. In the case of a mobile signal, an IF amplifier 68 boosts the selected signal 96 after filter 65.

In both cases, the amplification of the signal can be chosen between 14dB and 56dB by a gain controller 60. The amplification is performed with a high S/N ratio.

- 10 The objective of the RF stage 11 is to get an output power of 0 dBm at the end of the RF stage 11.

In the case of a base signal, amplifier 58 is connected to a limitation circuit 56 via signal 87. The limitation circuit 56, which is composed of diodes, protects the end of the RF stage 11 from voltage peaks that would be harmful to the following stages.

- 15 A filter 57 is connected to the limitation circuit 56 using signal 88. The filter 57 is composed of resistances and capacitors. The filter 57 is connected to a detection circuit 59 which converts the output signal 89 into a DC value comprised between 0 and 2.5 V, and proportionate to the output power of signal 89. The DC value is then used as a feedback reference in order to control the IF amplifiers 58 and to provide an output power signal closed to 0 dBm. The gain controller 60, that collects the feedback signal 91 comprises, in the preferred embodiment, a PIC 16C74 processor. In the preferred embodiment, the gain controller 60 adjusts the gain of amplifiers 58 and 68 each 46 msec. The gain controller 60 also comprises, in the preferred embodiment, an EEPROM which stores the relation between voltage signal and power in dBm. The output power computed by the gain controller 60 using signal 91 and 101 is transmitted to the management unit 15. In the preferred embodiment, the transmission is completed using a RS232 interface.

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In the case of a mobile signal, the amplifier 68 is connected to a limitation circuit 66 via signal 97. The limitation circuit 66, which is composed of diodes, protects the end of the RF stage 11 from voltage peaks that would be harmful to the following stages.

- 5 A filter 67 is connected to the limitation circuit 66 using signal 98. The filter 67 is composed of resistances and capacitors. The filter 67 is connected to a detection circuit 69 which converts the output signal 99 into a DC value comprised between 0 and 2.5 V, and proportionate to the output power. The DC value is then used as a feedback reference in order to control the IF amplifiers 68, using the gain
10 controller 60, and to provide an output power signal closed to 0 dBm.

- Referring to Fig. 2, an ADC stage 21 follows the RF stage 11. The ADC stage 21 converts signals 89 and 99. The conversion is performed at a rate of 75MHz, thus it more than satisfies Nyquist sampling theorem for the 25 MHz signal. The
15 quantization is 10 bits. It is important to notice that the device used for the analog to digital conversion has a high Signal/noise (S/N) ratio in the preferred embodiment. After the conversion, the information becomes a flow of digital information. A router 22, that is, in the preferred embodiment a FPGA, will then route this flow of information through the DDC 23. The router acts as a switch
20 which performs path selection between multiple parts. The choice of a FPGA is justified by the fact that it can be soft-configured very easily, and by the fact that it can handle very large amount of data (it has a large bandwidth). The router 22 is controlled by the management unit 15. The router 22 creates a data bus 28 that is connected to the DDC 23. Each DDC 23 is then able to collect data
25 coming from a particular unit 16. The DDC 23 is a tuneable down converter adapted to numerical signals.

- Each DDC 23 downconverts the signal 28 with a local oscillator and an in-phase and quadrature downconverter. The management unit 15 controls the DDC 23
30 and allows each DDC 23 to select a specific conversation.

Fig 4 describes more precisely the operations completed by the DDC 23.

In the preferred embodiment, the DDC 23 is an Intersil HSP50016. The goal of the DDC 23 is to extract a narrow frequency band of interest from a wideband input signal, convert that band to a baseband and output it in either a quadrature or a real form. In the present invention, the goal of each DDC is to select a voice channel coming either from the base station 13 or from the mobile unit 14 via the router 22, in order to intercept it.

The narrow band extraction is performed by down converting and centering the band of interest. The DDC 23 has an input data stream of 16 bits in width and 75 MSPS in data rate. As the ADC 21 performs the conversion with a quantization of only 10 bits, the six (6) Less Significant Bit (LSB) are grounded in order to maintain a good accuracy. The conversion is done by multiplying the input data 28 with a quadrature sinusoid generated by a complex sinusoid generator 110. In order to get the in-phase component (designated as I) 29 of the quadrature sinusoid, the signal 28 is multiplied by a cosine signal 130 in the mixer 111. In order to get the quadrature component (designated as Q) 30, the signal 28 is multiplied by a sine signal 135 in the mixer 120. The frequency of the complex sinusoid generator 110 of the DDC 23 can be selected by the management unit 15 in order to select a specific voice signal.

A quadrature lowpass filter 114 is applied to the output of the mixer 111. Another quadrature lowpass filter 123 of the same type of the above is connected to the output of the mixer 120. In the preferred embodiment, filtering chain 114 consists of a cascaded High Decimation Filter (HDF) 112 and a low pass FIR filter 113. The filtering chain 123, in a preferred embodiment, consists of a cascaded HDF 121 and a low pass FIR filter 122. The combined response of the two stages filters results in a -3dB to -102dB shape factor. Each filtering chain (114 and 123) is controlled by the management unit 15 according to the voice channel selected. The decimation factor is 4x78 in the case of AMPS. The decimation factor is 4x77 in the case of DAMPS.

Each DDC 23 provides the quadrature signal (Q) 30 and the in-phase component (I) signal 29 of a specific voice channel to tap. The output frequency of signal I 29 and signal Q 30 is 240.384 kHz in the case of AMPS. In the case of DAMPS, the output frequency of signal I 29 and signal Q 30 is 243.506 kHz.

- 5 The signals 29 and 30 are filtered through a FIR 24. In the preferred embodiment, FIR 24 is a HSP43124SC-33 which is programmable. The FIR filter 24 is controlled by the management unit 15 which provides the coefficients for the right protocol.

- In the case of AMPS and in the preferred embodiment, the algorithm of Parks-McClellan is used to compute the coefficients of the order 233 FIR 24. The
10 algorithm of Parks-McClellan is also used to compute the coefficients of the order 233 FIR 24 in the case of DAMPS. In the case of GSM and CDMA, a similar approach is used to compute the coefficients of the FIR 24. In the preferred embodiment, the low pass frequency of the filter FIR 24 is 12.4 kHz; and the
15 attenuation is 80 dB at 17.6 kHz in the case of AMPS and DAMPS.

The signals 31 and 32 are available for demodulation according to the protocol used for the transmission.

What is claimed is:

1. A multi-protocol receiver for receiving wireless transmissions comprising:

a plurality of RF receiver units each receiving a wireless signal and outputting a broadband IF signal;

at least one tunable down converter unit, each able to tune over a frequency range of all of said broadband IF signal of all of said RF receiver units, said tunable down converter units output raw I and Q signals;

at least one tunable filter receiving said raw I and Q signals from one of said at least one tunable down converter units and providing filtered I and Q output signals;

a switch for connecting a selected RF receiver unit to a selected one of at least one of said tunable down converter;

a management unit receiving a request for a specific frequency band and setting a tuning frequency of a selected one of a plurality of at least one tunable down converter unit, setting filter parameters of a selected one of a plurality of at least one of said tunable filter, and setting said switch.

2. The receiver as claimed in claim 1, further comprising a plurality of ADC units each connected to one of said RF units, wherein said switch connects a broadband digital output of said ADC units to said tunable down converter units.

3. The receiver as claimed in claim 1 wherein the management unit comprises:

a channel selection signal input;

a memory for storing said filter parameters for channels from said broadband IF signal of all of said RF receiver units and frequency parameters for all of said tunable down converter units and switch parameters;

an interpreter receiving said selection signal and setting said filter parameters, said tunable down converter, and said switch parameters based on data stored in said memory.

4. The receiver as claimed in claim 2 wherein the management unit comprises:
- a channel selection signal input;
 - a memory for storing said filter parameters for channels from said broadband IF signal of all of said RF receiver units and frequency parameters for all of said tunable down converter units and switch parameters;
 - an interpreter receiving said selection signal and setting said filter parameters, said tunable down converter, and said switch parameters based on data stored in said memory.
5. The receiver as claimed in claim 1 wherein there are at least two of said tunable down converter units in order to receive full duplex conversations.
6. The receiver as claimed in claim 2 wherein there are at least two of said tunable down converter units in order to receive full duplex conversations.
7. The receiver as claimed in claim 3 wherein there are at least two of said tunable down converter units in order to receive full duplex conversations, said memory for storing switch parameters provides information for allocating said at least two of said tunable down converter units to said full duplex conversations.
8. The receiver as claimed in claim 1, wherein a plurality of said RF units, each receives a portion of a single frequency band.
9. The receiver as claimed in claim 1, wherein a single frequency band, larger than one handled by a single one of said RF unit, is handled by a plurality of said RF units.
10. The receiver as claimed in claim 2 wherein said at least one tunable filter is an N tap FIR filter.
11. The receiver as claimed in claim 2 wherein said switch is an FPGA.
12. The receiver as claimed in claim 1 wherein each of said RF receiver unit handles at least 25 MHz bandwidth signal.
13. The receiver as claimed in claim 2 wherein each of said ADC units performs the conversion at a rate of at least 50 MHz.

14. A method for receiving a wireless communication with a device which comprises a plurality of RF receiver units, at least one tunable down converter unit, at least one tunable filter, a switch and comprising the steps of:

receiving a wireless signal from an antenna and outputting an IF broadband signal;

switching said switch in order to connect one of said RF receiver units to one of said tunable down converter units;

down converting the IF broadband signal to provide a raw I and Q signals;

filtering the raw I and Q signals to provide I and Q signals.

15. A method as claimed in claim 14 additionally comprising the step of:

digitizing said IF broadband signal by an ADC unit before said switching.

16. A method as claimed in claim 14 wherein the step of switching said switch is directed by a management unit.

17. A method as claimed in claim 15 wherein the step of switching said switch is directed by a management unit.

18. A method as claimed in claim 14 wherein a management unit and comprising the steps of:

receiving at least one selected channel input signal;

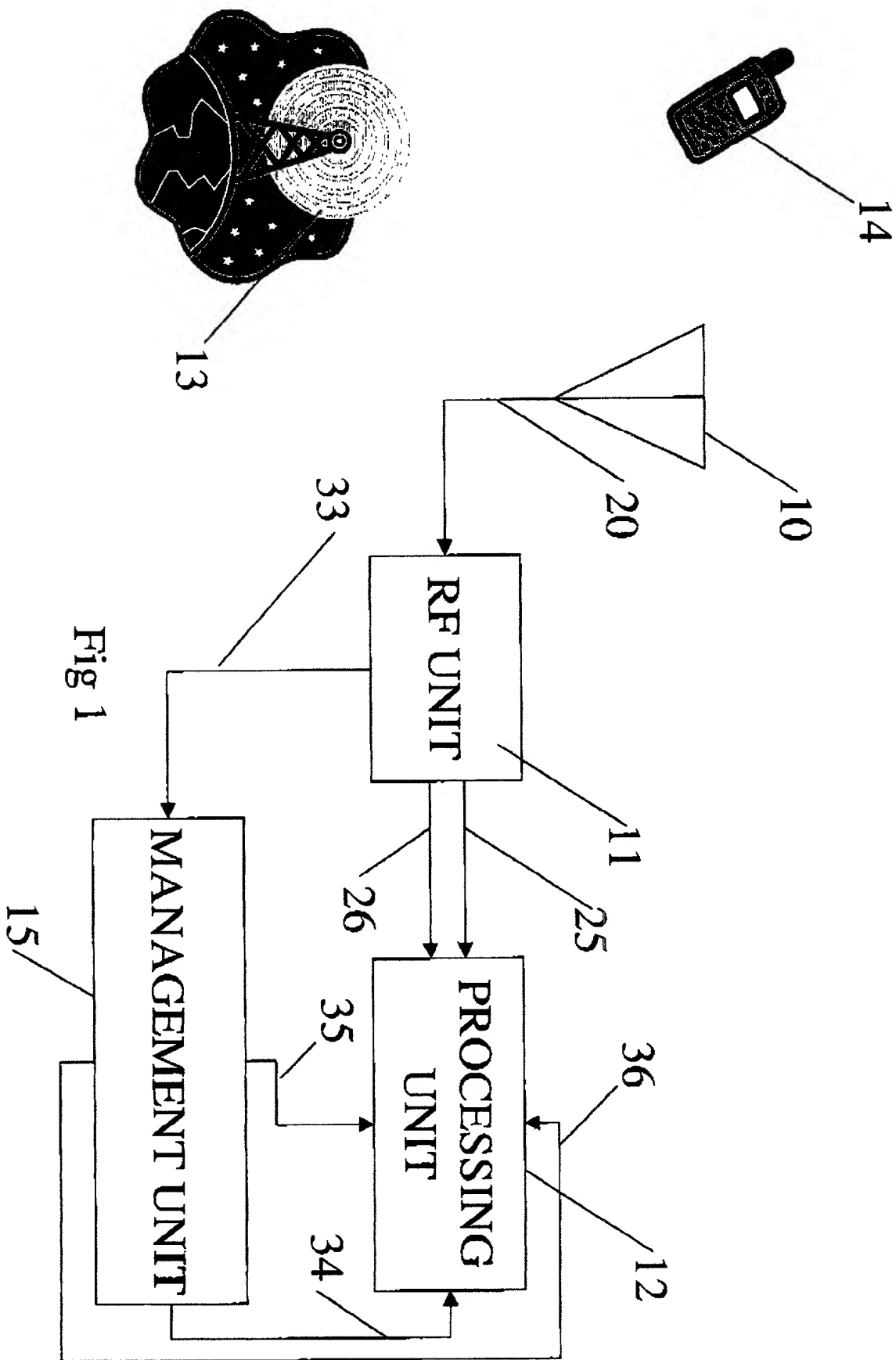
interpreting said received selected channel input signals to provide parameters for said at least one of said tunable down converter units, for said at least one of said tunable filter units, for said switch.

19. The management unit as claimed in claim 3 wherein the central processing unit is a Digital Signal Processor (DSP).

ABSTRACT

A multi-protocol receiver system for receiving wireless communications. The system comprises programmable stages for controlling each steps of the demodulation of at least one broadband signal to provide the I and Q signals of at least one specific frequency narrow band for further processing. The receiver can be used in a software defined radio system.

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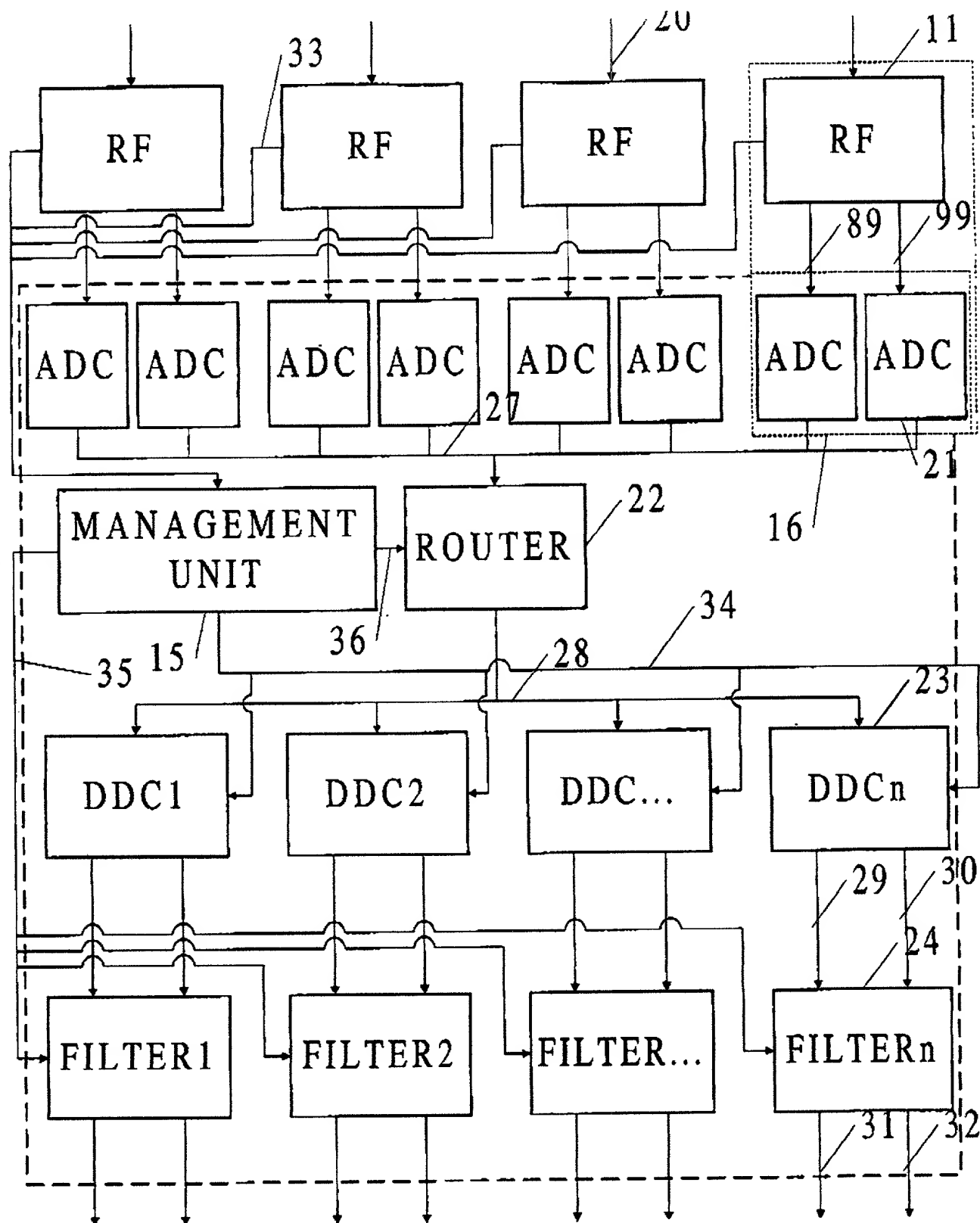


Fig 2

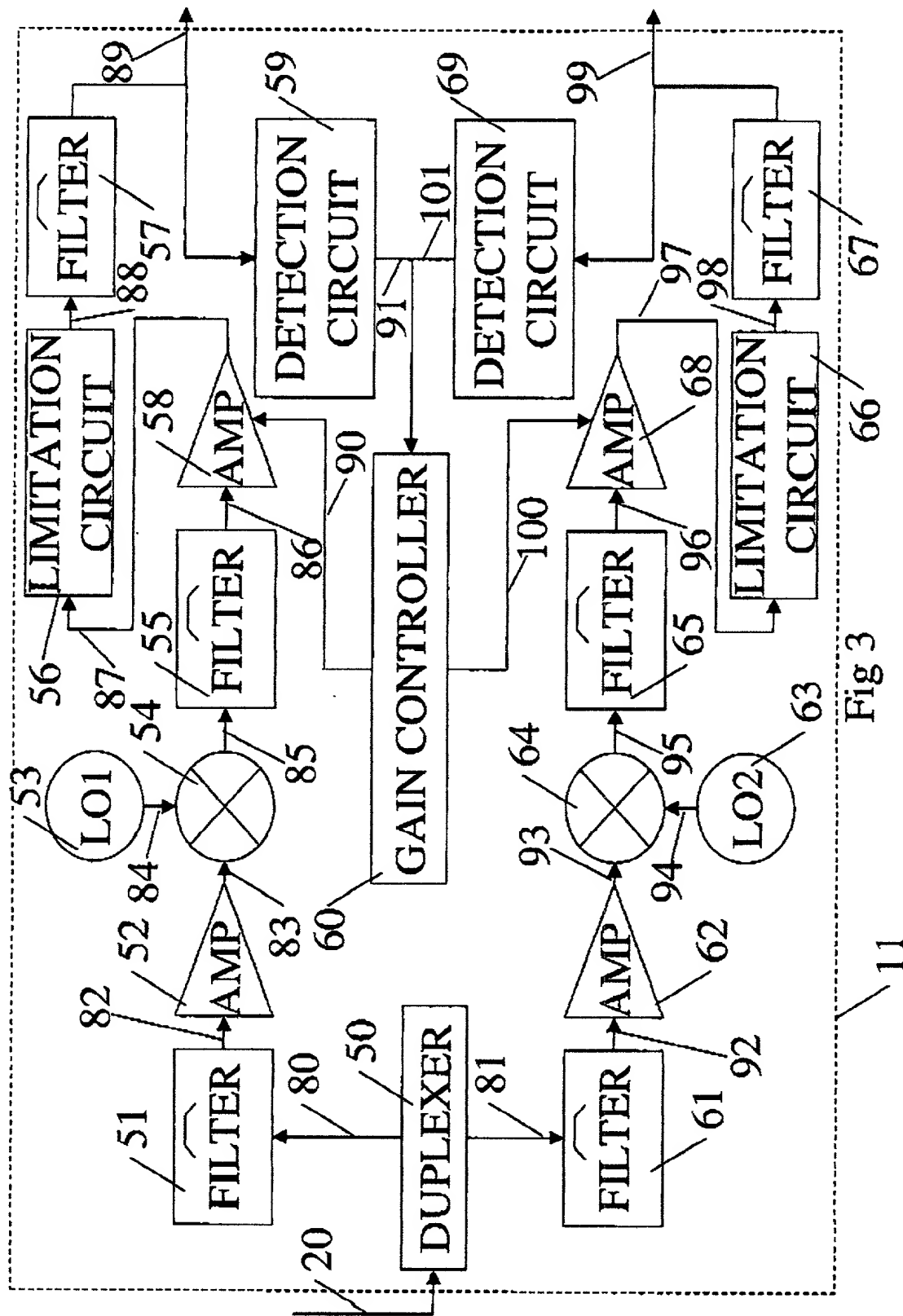


Fig 3

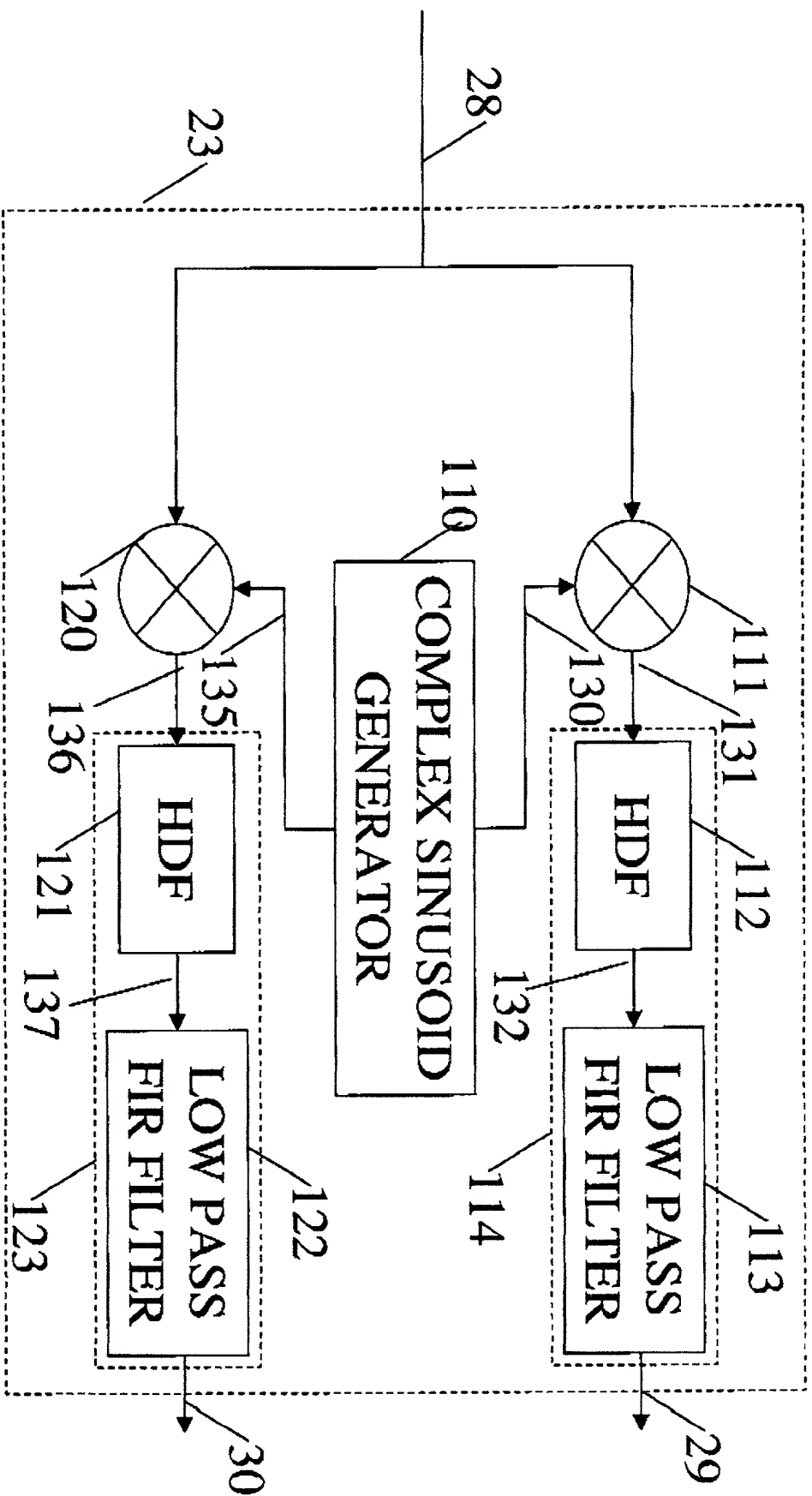


Fig 4

09629892.073400

Declaration and Power of Attorney for Patent Application

Déclaration et Pouvoir pour Demande de Brevet

French Language Declaration

En tant qu'inventeur ci-après désigné, je déclare par la présente que:

Mon domicile, mon adresse postale et ma nationalité sont tels que figurant ci-dessous à côté de mon nom.

Je crois être le premier inventeur original et unique (si un seul nom est mentionné ci-dessous), ou l'un des premiers co-inventeurs originaux (si plusieurs noms sont mentionnés ci-dessous) de l'objet revendiqué, pour lequel une demande de brevet a été déposée concernant l'invention intitulée

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated next to my name.

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled

MULTI-PROTOCOL RECEIVER

et dont le mémoire descriptif est ci-joint à moins que la case suivante n'ait été cochée:

☐ a été déposée le _____ sous le numéro de demande des États-Unis ou le numéro de demande internationale PCT _____ et modifiée le _____ (le cas échéant).

Je déclare par la présente avoir révisé et compris le contenu du mémoire descriptif ci-dessus mentionné, incluant les revendications, telles que modifiées par toute modification ci-dessus mentionnée.

Je reconnais devoir divulguer toute information pertinente à la brevetabilité, tel que défini dans le Titre 37, §1.56 du Code fédéral des réglementations.

Je revendique par la présente la priorité étrangère, en vertu du Titre 35, §119(a)-(d) ou §365(b) du Code des États-Unis, sur toute demande étrangère de brevet ou certificat d'inventeur ou, en vertu du Titre 35, §365(a) du même Code, sur toute demande internationale PCT désignant au moins un pays autre que les États-Unis et figurant ci-dessous et, en cochant la case, j'ai aussi indiqué ci-dessous toute demande étrangère de brevet, tout certificat d'inventeur ou toute demande internationale PCT

the specification of which is attached hereto unless the following box is checked:

☐ was filed on _____ as United States Application Number or PCT International Application Number _____ and was amended on _____ (if applicable).

I hereby state that I have reviewed and understand the contents of the above identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations., §1.56.

I hereby claim foreign priority under Title 35, United States Code, §119(a)-(d) or §365 (b) of any foreign application(s) for patent or inventor's certificate, or §365(a) of any PCT International application which designated at least one country other than the United States, listed below, and have also identified below, by checking the box, any foreign application for patent or inventor's certificate, or PCT International application having a filing date before that of the application

French Language Declaration

ayant une date de dépôt précédant celle de la demande à propos de laquelle une priorité est revendiquée.

on which priority is claimed.

Prior foreign application(s)
Demande(s) de brevet antérieure(s)

Priority Not Claimed
Droit de priorité non revendiqué

(Number) (Country)
(Numéro) (Pays)

(Day/Month/Year Filed)
(Jour/Mois/Année de dépôt)

☐

(Number) (Country)
(Numéro) (Pays)

(Day/Month/Year Filed)
(Jour/Mois/Année de dépôt)

☐

Je revendique par la présente tout bénéfice, en vertu du Titre 35, §119(e) du Code des États-Unis, de toute demande de brevet provisoire effectuée aux États-Unis et figurant ci-dessous.

I hereby claim the benefit under Title 35, United States Code, §119(e) of any United States provisional application(s) listed below.

(Application No.)
(N° de demande)

(Filing Date)
(Date de dépôt)

Je revendique par la présente tout bénéfice, en vertu du Titre 35, §120 du Code des États-Unis, de toute demande de brevet effectuée aux États-Unis, ou en vertu du Titre 35, §365(c) du même Code, de toute demande internationale PCT désignant les États-Unis et figurant ci-dessous et, dans la mesure où l'objet de chacune des revendications de cette demande de brevet n'est pas divulgué dans la demande antérieure américaine ou internationale PCT, en vertu des dispositions du premier paragraphe du Titre 35, §112 du Code des États-Unis, je reconnais devoir divulguer toute information pertinente à la brevetabilité, tel que défini dans le Titre 37, §1.56 du Code fédéral des réglementations, dont j'ai pu disposer entre la date de dépôt de la demande antérieure et la date de dépôt de la demande nationale ou internationale PCT de la présente demande:

I hereby claim the benefit under Title 35, United States Code, §120 of any United States application(s), or §365(c) of any PCT International application designating the United States, listed below and, insofar as the subject matter of each of the claims of this application is not disclosed in the prior United States or PCT International application in the manner provided by the first paragraph of Title 35, United States Code, §112, I acknowledge the duty to disclose information which is material to patentability as defined in Title 37, Code of Federal Regulations, §1.56 which became available between the filing date of the prior application and the national or PCT International filing date of this application.

(Application No.) (Filing Date)
(N° de demande) (Date de dépôt)

(Status) (patented, pending, abandoned)
(Statut) (breveté, en cours d'examen, abandonné)

(Application No.) (Filing Date)
(N° de demande) (Date de dépôt)

(Status) (patented, pending, abandoned)
(Statut) (breveté, en cours d'examen, abandonné)

French Language Declaration

Je déclare que toute les déclarations faites dans la présente sont à ma connaissance, véridiques et que toutes les déclarations faites à partir de renseignements ou de suppositions sont tenues pour véridiques; et de plus, que toutes ces déclarations ont été faites en sachant que toute fausse déclaration volontaire ou son équivalent est passible d'une amende ou d'une peine d'emprisonnement, ou des deux, en vertu de la Section 1001 du Titre 18 du Code des États-Unis, et que de telles déclarations volontairement fausses risquent de compromettre la validité de la demande de brevet ou du brevet délivré à partir de celle-ci.

POUVOIR: En tant qu'inventeur désigné, Je nomme par la présente l'(les) avocat(s) et/ou agent(s) suivant(s), avec plein pouvoir de révocation et de substitution, chargés de poursuivre cette demande et de traiter toute affaire s'y rapportant avec l'Office des brevets et des marques: (*mentionner le nom et le numéro d'enregistrement*).

I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

POWER OF ATTORNEY: As a named inventor, I hereby appoint the following agents and/or attorneys, with full power of substitution, association, and revocation, to prosecute this application and to transact all business in the Patent and Trademark Office connected therewith. (*list name and registration number*)

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Residence and Post Office address (Domicile et adresse postale)	Inventor's signature (signature de l'inventeur)	
Full name of second inventor (Nom complet du second co-inventeur)	Citizenship (Nationalité)	Date (dd/mm/yyyy) (jj/mm/aaaa)
Residence and Post Office address (Domicile et adresse postale)	Second Inventor's signature (signature du second inventeur)	
Full name of third co-inventor (Nom complet du troisième co-inventeur)	Citizenship (Nationalité)	Date (dd/mm/yyyy) (jj/mm/aaaa)
Residence and Post Office address (Domicile et adresse postale)	Third Inventor's signature (signature du troisième inventeur)	
Full name of fourth co-inventor (Nom complet du quatrième co-inventeur)	Citizenship (Nationalité)	Date (dd/mm/yyyy) (jj/mm/aaaa)
Residence and Post Office address (Domicile et adresse postale)	Fourth Inventor's signature (Signature du quatrième inventeur)	